Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Content of

S.Y. B. Tech. (Electrical Engineering) Sem- III (ODD)

2021-22

Professional Core (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Probability and Statistics
Desired Requisites:	Mathematics course at Higher Secondary Junior College

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	Familiarize the students with techniques in multivariate integration and statistics.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Apply** computational tools to solve Mathematical and Statistical problems	Applying
CO2	**Solve** problems in probability , statistics and multivariable calculus.	Applying

Module	**Module Contents**	**Hours**
I	**Random Variable** Discrete random variable , Continuous random variable , Probability mass function, cumulative distribution function, Bivariate discrete random variable, Joint probability distribution Joint distribution function of two dimensional discrete random variable.	4
II	**Probability Distribution** Gaussian Distribution, Exponential Distribution, Uniform Distribution	4
III	**Statistical Methods** Measure of central tendency , measure of dispersion , range, Quartile deviation , mean deviation , Variance, Standard deviation, coefficient of variance, Moments, Symmetry, Skewness , Kurtosis and types of kurtosis	5
IV	**Population and Sample** Introduction, Types of Characteristics: Attributes and Variables, Collection and Organization of data, Population and sample , Methods of Sampling.	3
V	**Exact Sampling Distribution** Chi-square distribution : Definitions and its properties, Student t-distribution: Definitions and its properties,.	4
VI	**Test of Hypothesis** Random samples , Parameter, statistic, standard error of Statistic, null and alternative hypothesis, critical region, level of significance, Types of error, large sample test, small sample test	7

Text Books	
1	Fundamentals of Mathematical Statistics by Gupta and Kapoor .
2	An Introduction to Probability and Statistics by Vijay Rohatgi

References	
1	Probability and Statistics for Engineers and Scientists by S. Ross
Useful Links	
1	https://www.youtube.com/watch?v=aKohB8lPueg

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**													
CO2	**2**	**3**													
CO3															

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High

Each CO of the course must map to at least one PO.

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	20	20	60	100
4	Analyze				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	DC Machines and Transformers
Desired Requisites:	Basic Electrical Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	This course intends to provide basic concept of DC machines and transformers.
2	It intends to develop skills to evaluate ratings of DC machines and transformers for various applications.
3	It intends to solve problems on DC machines and transformers.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Explain** the working principles, Construction, operation and application of DC machines, universal motors and transformers.	Understanding
CO2	**Discuss** numerical problems on DC machines, transformer and universal motor	Applying
CO3	**Analyze** the performance of DC machines, transformers and universal motor.	Analyzing

Module	**Module Contents**	**Hours**
I	**DC Machines** **Constructional Details**: Construction of D.C. machines, magnetic circuit of DC machines, commutator and brush arrangement, EMF equation, torque equation, power flow diagram of D.C. machines. **Armature Winding**: Simple lap winding and wave winding, winding diagram and tables, brush position, dummy coils. **Armature Reaction**: MMF due to armature winding, flux distribution due to armature current and resultant flux distribution in a machine. Demagnetization and cross magnetization ampere turns, principle of compensation, compensating winding and its use in machines.	8
II	**D.C. Motors** Concept of back e.m.f., characteristics of D.C. motors, Method of speed controls, electro braking, parallel and series operation of motor. **Testing of D.C. Machines**: Losses and efficiency, Break test, Swinburn's test, Hopkinson's test, Retardation test, Field test on D.C. series motor.	8
III	**Single Phase Transformer** Construction and type, EMF equation phasor diagram, equivalent circuit, efficiency, losses, regulation, Experimental determination of equivalent circuit parameters and calculation of efficiency and regulation, parallel operation, auto transformer principle and connections.	8

IV	**Poly Phase Transformer** Construction, single phase bank, polarity test, transformer winding, v-v connection and Scott connection, Vector Grouping YD1, YD11, DY1, DY11, DZ0, DZ 6, YZ1, YZ11.	5
V	**Performance of Transformers** Switching inrush current, on load and off load tap changing, Harmonics in exciting current causes and effects, Harmonics with different transformer connections, tertiary winding, oscillating neutral, Testing of transformer as per IS, heat run test, Sumpner's test and equivalent delta test.	6
VI	**Universal Motor** Development of torque & power, rotational and transformer emf in commutator winding, commutation in universal motor, complexor diagram, circle diagram, operation on A.C. and D.C. supply, compensated winding, applications.	4

Text Books	
1	A.E.Clayton and Hancock, "*The Performance and Design of Direct Current Machines",* CBS Publishers, 1st Edition, 2004.
2	M. G. Say. *"The Performance and Design of Alternating Current Machines",* CBS Publishers, 3rd Edition, 2004.
3	O. E. Taylor, *"Performance Design of AC commutator motors",* Wheeler Publisher, 15th Reprint.

References	
1	Purkaitand Bandyopadhyay *"Electrical Machines"*, Oxford University Press, 1st Edition, 2017.
2	J. B. Gupta, *"Theory and Performance of Electrical Machines"*, S.K.Kataria and Sons, 1st Edition, 2013.
3	Fitzerald and Kingsley, *"Electric Machines"*, Tata McGraw Hill, 7th Edition, 2007.
4	Kothari and Nagrath, *"Electric Machines"*, McGraw Hill, 5th Edition, 2018.

Useful Links	
1	https://nptel.ac.in/courses/108/105/108105017/
2	

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												2		
CO2		3											3		
CO3		3												3	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10	10	30	50
3	Apply	5	5	20	30
4	Analyze	5	5	10	20
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Electrical Circuits
Desired Requisites:	Engineering Mathematics I

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	This course intends to develop an understanding of the fundamental laws and elements of electric circuits.
2	It will make students to learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks.
3	The course intends to introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Determine** voltages, currents, powers, and equivalence of a.c. and d.c. circuits using electrical circuit theorems.	Understanding
CO2	**Calculate** the transient and steady state response of first and second order circuits.	Applying
CO3	**Analyze** the parameters of two port electrical circuits and networks.	Analysing

Module	**Module Contents**	**Hours**
I	**DC Circuits** Ohm's law, Kirchhoff's law, dependent and independent sources, nodes, branches, loops, voltage and current division, Wye Delta transformations, nodal analysis, mesh analysis, linearity property, superposition theorem, source transformation, Thevenin's and Norton's theorem, maximum power transfer.	8
II	**First Order Circuits** Capacitors, Series and Parallel Capacitors, Inductors, Series and Parallel Inductors, Source free RC, RL circuits, step response of RC, RL, circuits	5
III	**Second Order Circuits** Finding initial and final values, source free series and parallel RLC circuits, step response of series and parallel RLC circuits, general second order circuits.	6

IV	**AC Circuits** Sinusoids, phasors, impedance and admittance, sinusoidal steady state analysis, nodal and mesh analysis, superposition theorem, source transformation, Thevenin's and Norton's equivalent circuit.	8
V	**Power in AC Circuits** Instantaneous and Average Power, Maximum Average Power, RMS Value, Apparent Power and Power factor, Complex Power, mutual inductance, dot convention, energy in coupled circuits.	6
VI	**Two Port Network** Impedance parameters, admittance parameters, hybrid parameters, transmission parameters, series connection of two two-port network, parallel connection of two two-port network, cascade connection of two two-port network	6

Text Books	
1	C. K. Alexandar and M.O. Sadiku, "*Fundamentals of Electric Circuits*", McGraw Hill EducationMH, 6th Edition,2018, ISBN: 9780078028229
2	Hayt, Kemmerly, Durbin, "*Engineering Circuit Analysis*", TMH, 8th Edition, 2012, ISBN: 9781259098635

References	
1	James W. Nilsson and Susan A. Riedel "*Electric Circuits*" Prentice Hall, 10th Edition, 2015, ISBN: 0131989251
2	L.P. Huelsman, "*Basic Circuit Theory*", Prentice Hall, 3rd Edition, 2009, ISBN: 9788120309715

Useful Links	
1	https://nptel.ac.in/courses/108/106/108106172/
2	https://nptel.ac.in/courses/108/105/108105159/
3	https://nptel.ac.in/courses/108/104/108104139/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		3													
CO3		3													

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		20	30
3	Apply	10	10	20	40
4	Analyze		10	20	30
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Analog and Digital Circuits
Desired Requisites:	Basic Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course aims to introduce students the basic features of operational amplifier.
2	It intends to provide knowledge and experience for implementing simple electronic circuits to meet or exceed design specifications.
3	It is aimed to enable students for implementing combinational logic circuits for various applications.
4	It intends to provide knowledge for implementation of sequential circuits using flip-flops.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Summarize** various analog and digital circuits.	Understanding
CO2	**Implement** analog and digital circuits to meet stated applications	Applying
CO3	**Construct** basic analog filters, combinational and sequential circuits	Applying
CO4	**Analyze** the performance of electronic circuits	Analysing

Module	**Module Contents**	**Hours**
I	**Fundamentals of Op-Amps** Differential Amplifier(1st stage of OP-AMP), Ideal Operational Amplifiers, Block Diagram, Characteristics, op-amp powering, feedback in op-amp circuits, inverting, non-inverting amplifiers, adder, subtractor, voltage comparator, difference amplifier, op-amp parameters & ratings	6
II	**Applications of Opamps** Instrumentation amplifier, Integrator, Differentiator, Schmitt trigger, Active filters-Low pass, high pass, band pass, all pass, band reject (notch) filters, Current to voltage convertor, voltage to current convertor, precision rectifier, peak detector, sample & hold circuit, Logarithmic Amplifier,Multivibrators: IC 555Astable, Monostable and Bistable	7
III	**Transistor Amplifiers and Voltage Regulators** Introduction, Types of Configuration: common base, common emitter and common collector configurations, operating point, stability and biasing circuits, Design of Amplifier : Common Emitter mode Voltage regulators, short circuit protection, fixed voltage regulators (± 5 V, ± 12 V).	5

IV	**Combinational Circuits and Sequential Circuits** Review of k-map minimization technique for multiple outputs, static & dynamic hazards, multiplexer, de-multiplexer, priority encoder, comparator, half & full adders, tri-state buffers. Latches – S-R latch, D latch, flip-flops- D F/F, J-K F/F,T F/F, master slave J-K F/F, conversion of one F/F to another F/F.	7
V	**Applications of Sequential circuits** Counters:Modulus of Counter, Synchronous and Asynchronous counters, Ripple counters, drawbacks of ripple counters, Ring counters, Twisted Ring Counters, Shift registers, types of shift registers, design using D, J-K & T F/Fs.	6
VI	**Digital to Analog and Analog to Digital Converters** Binary weighted DAC, R-2R ladder DAC, Ramp ADC, dual slope ADC, successive approximation technique, flash ADC, voltage, current and phase angle measurement (block level treatment only).	5

Text Books	
1	Sergio Franco, "*Design with Op-Amps and analog Integrated Circuits*", Tata McGraw-Hill Publication, Third Edition, 2001
2	Allen Mottershead, "*Electronic Devices &Circuits: An Introduction*", Prentice Hall India, 2010
3	A. Anand Kumar, "*Fundamentals of Digital Circuits*", Prentice Hall India, Fourth Edition, 2014

References	
1	R.A. Gayakwad, "*Op-Amps & Linear Integrated Circuits*", Prentice Hall India, Fourth Edition, 2012.
2	R. L. Boylestad and Louis Nashelsky, "*Electronic Devices & Circuit Theory*", Pearson Publications, Tenth Edition, 2009.
3	M. Moris Mano and Michael Ciletti, "*Digital Design*", Pearson Publications, Fifth Edition, 2013

Useful Links	
1	https://nptel.ac.in/courses/108/102/108102112/
2	https://nptel.ac.in/courses/108/102/108102095/
3	https://nptel.ac.in/courses/108/105/108105132/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3			3											
CO2			3												
CO3			3												
CO4		3													

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		20	30
3	Apply	10	10	20	40
4	Analyze		10	20	30
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Electrical Measurement
Desired Requisites:	Basic Electrical Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	This course intends to provide basic concepts of errors in measurements and basic fundamentals of measuring systems. formal representation, computational methods, notation, and vocabulary of linear models.
2	It is aimed to impart skills to classify bridges, measuring instruments and equipment's and also demonstrates digital instruments, advance instruments.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Grasp** fundamental concepts of measurement and identify errors in measurement and its statistics.	Understanding
CO2	**Explain** working principle and mechanism of measuring instrument.	Understanding
CO3	**Use** a proper measuring instrument and modern techniques for measurement of electrical parameters for given application.	Applying
CO4	**Identify** conventional and modern techniques for measurement of electrical parameters.	Analyzing

Module	**Module Contents**	**Hours**
I	**Structure of Measurement System** Units, Dimensions and Standards, Structure of Measurement Systems, Instrument Types-Active, Passive, Examples of Laboratory Instruments.	4
II	**Characteristics of Measuring Instruments and Errors** Static Characteristics of Instruments, Dynamic Characteristics of Instruments, Measurement Errors.	4
III	**Measuring Instruments** Absolute and secondary instruments, types of Secondary Instruments: indicating, integrating, and recording, analog & digital Ammeter and Voltmeter theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) (attraction and repulsion), Permanent Magnet Moving Coil (PMMC) and Dynamometer type instruments	7

IV	**Measurement of Power and Energy** Active and reactive power measurement in three phase system for balanced and unbalanced load using two wattmeter method & one wattmeter method. Construction, working principle, torque equation of single phase conventional (induction type) energy meter, Calibration of energy meter, digital Energy Meter, block diagram and operation of electronic energy meter.	7
V	**Measurement of Resistance, Inductance and Capacitance** Measurement of low, medium and high resistance, Wheatstone Bridge, Kelvin's Double Bridge, Ammeter-Voltmeter method, Megger, Earth tester for earth resistance measurement, Maxwell's Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge and Wien's Bridge.	7
VI	**Recent developments in Measurements** DSO, Power Analyzer, Wave Analyzer & Harmonic Distortion, and Instrument Transformers: Construction, connection of CT & PT in the circuit, advantages of CT / PT, over shunt and multipliers for range extension of MI Instruments.	7

Text Books	
1	Alan Morris "*Principles of measurement and instrumentation*", Prentice Hall- India, 2004 ISBN: 0134897099
2	A. K. Sawhney, "*Measurement and instruments*", Dhanpat Rai, 2002. ISBN- 8177001000
References	
1	Albert D. Helfric, "*Modern Electronics measurement & instruments*", PHI Ltd, 2003
Useful Links	
1	https://nptel.ac.in/courses/108/105/108105153

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2												
CO2			2												
CO3					2										
CO4											2				

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	15	10	20	45
3	Apply	05	05	20	30
4	Analyze		05	20	25
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Instrumentation
Desired Requisites:	Control System

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	To impart basic knowledge of transducer.
2	To develop skills of instrumentation systems design.
3	To learn basics of PLC programing.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Explain** the various types of transducer and their application.	Understand
CO2	**Implement** the instrumentation system for measurement of physical parameters.	Apply
CO3	**Demonstrate** the use of PLC for industry applications.	Apply

Module	**Module Contents**	**Hours**
I	**Instrumentation System** Concept of physical process and control, Instrumentation system- overview, component of system and system feedback, data acquisition system, performance characteristics, calibration of Instrumentation System. Sensors and Transducers- overview, definition, classification, selection criteria, concept of error, signal conditioning.	6
II	**Transducers- Pressure, Flow, Motion and Dimension** Transducers for pressure and strain measurement, type of strain gauges, LVDT and RVDT, flow measurement technique, inferential type, variable head & area, magnetic meters, turbine meters, thermal flow meter, piezoelectric pickups , jerk pickups, pendulous-angular displacement, coordinate measurements.	7
III	**Transducers - Temperature ,Speed, Force and Shaft power** Temperature measurement, temperature scale, classification. Methods of force measurement, eddy current dynamometer, Speed- definition, types of tachometer, synchro -transmitter and receiver, Torque measurement on rotating shaft, gyroscopic force and torque ,	7
IV	**Output Devices** Analog display, Oscilloscope, X-Y recorders, Digital data recorders, Digital input and output devices, LCD, LED, DPM, 7 segments displays.	4

V	**DCS and SCADA system** Benefits of automation, Introduction to automation tools DCS, SCADA, Hybrid DCS, DCS- Basic Introduction, analog control, direct digital control, distributed process control, DCS configuration with associated accessories, local control units, DCS System Integration I/O hardware stations, Supervisory Computer Tasks.	6
VI	**Programmable Logic Controller** Introduction to discrete state process control, specification, event sequence description, ladder diagram, relay logic controller, comparison of PLC with relay logic controller, architecture of PLC, operating modes of PLC, difference between PLC and PC, ladder diagram programming of various system, role of PLC in Industry.	6

Text Books	
1	A.K.Sawhney, *"A Course in Electrical and Electronics Measurement and Instrumentation",* Dhanapat Rai & Company, New Delhi, reprint, 17th Edition, 2005.
2	Rangan, Mani and Sharma, *"Instrumentation Devices and Systems",* Tata McGraw Hill, New Delhi, 2nd Edition.
3	C. D. Johnson, *"Process Control Instrumentation Technology",* Pearson Education.
References	
1	Doebelin, E.O., *"Measurement Systems",* McGraw Hill Book Co.
2	Patranabis, D*, "Sensors and Transducers",* Wheeler Publishing Co., Ltd. New Delhi.
3	Murthy, D.V.S., *"Transducers and Instrumentation",* Prentice Hall of India Pvt. Ltd., New Delhi.
Useful Links	
1	https://nptel.ac.in/courses/108/105/108105064/

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1					2										
CO2			2												
CO3					2										

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	15	10	30	55
3	Apply	05	10	30	45
4	Analyze				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Professional Core (Lab) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	DC Machines and Transformers Lab
Desired Requisites:	Basic Electrical Engineering Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs				
Interaction	-	**Credits: 1**			

Course Objectives	
1	To develop skills to demonstrate performance operation of DC motors & transformers using different tests.
2	To develop skills to analyze operation and performance of DC machines & transformers.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Experiment** for verification of electrical characteristics and performance of DC Machines and transformer.	Apply
CO2	**Analyse** the performance of DC Machines and transformer.	Analyse
CO3	**Develop** appropriate circuit connections and determine ratings of meters to conduct an experiment as a group activity.	Analyse

List of Experiments / Lab Activities

List of Experiments:

1. Speed control of dc shunt motor (i) Armature control method (ii) Field control method.
2. Determination of efficiency of DC motor by Swinburne's test.
3. Determination of efficiency of DC motor by Hopkinson's test.
4. Brake test on shunt motor to determine its performance and efficiency.
5. Load test on compound motor i) cumulative ii) differential.
6. To perform open circuit and short circuit test for determining equivalent circuit parameters of a single phase transformer.
7. Parallel operation of single phase transformer to demonstrate load sharing.
8. Scott connections for converting 3 phase to 2 phase supply.
9. Equivalent Delta test or Heat run Test for determination of temperature rise and efficiency of 3 phase transformer.
10. Parallel connection of 3 phase DY1 and DY11 transformers to demonstrate load sharing.
11. Load test on transformer (single and three phase) to determine losses and efficiency using Sumpner's test.
12. Develop a circle diagram of Universal motor using load test.

Text Books

1	A. E. Clayton and Hancock, *"The Performance and Design of Direct Current Machines",* CBS Publishers, 1st Edition, 2004.

2	M. G. Say. *"The Performance and Design of Alternating Current Machines",* CBS Publishers, 3rd Edition, 2004.
3	O. E. Taylor, *"Performance Design of AC Commutator motors"*, Wheeler Publisher, 15th Reprint.
References	
1	Purkaitand Bandyopadhyay *"Electrical Machines",* Oxford University Press, 1st Edition, 2017.
2	J. B. Gupta*, "Theory and Performance of Electrical Machines",* S.K.Kataria and Sons, 1st Edition, 2013.
3	Fitzerald and Kingsley, *"Electric Machines"*, Tata McGraw Hill, 7th Edition, 2007.
4	Kothari and Nagrath, *"Electric Machines"*, McGraw Hill, 5th Edition, 2018.
Useful Links	
1	---------

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1					3										
CO2				3											
CO3				2	1										
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	5	15	**35**
Analyze	15	25	25	**65**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Electrical Circuit and Measurement Lab
Desired Requisites:	Basic Electrical Engineering Lab

Teaching Scheme (Hrs)		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2				
Interaction	-	**Credits: 1**			

Course Objectives

1	This course intends to provide basic practical knowledge of electrical circuit theorems.
2	It intends to develop skills to demonstrate transient and steady state response of first and second order electrical circuit.
3	It aims to develop an ability to simulate and implement various basic electrical circuits.
4	It intends to develop skills for measurement and instrumentation system.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Determine** parameters of electrical circuits and two port network using hardware and simulation.	Understand
CO2	**Explain** the transient and steady state response of first and second order circuit using hardware and simulation.	Understand
CO3	**Employ** measurement and instrumentation system for measurement of electrical and physical parameters.	Apply

List of Experiments / Lab Activities

List of Experiments:

1. Implementation of Mesh and Node analysis to measure current and voltage in D.C. circuit using software tool PSpice.
2. Verification of Superposition Theorem to measure current and voltage in electrical circuit using hardware and validate the result using software tool PSpice.
3. Verification of Thevenin's and Norton's Theorem to obtain equivalent circuit using hardware and validate the result using software tool PSpice.
4. Determine transient and steady state behavior of a first order circuit (R-C circuit) on hardware and validate the results using software tool PSpice.
5. Determine transient and steady state behavior of a second order circuit (R-L-C circuit) using software tool PSpice.
6. Determine Impdenace, Admittance, Transmission and Hybrid parameters of two port electrical network using hardware and validate the result manually.
7. Implementation of Mesh and Node analysis to measure current and voltage in A.C. circuit using software tool PSpice.
8. Determine active power using two wattmeter method and reactive power using one wattmeter method in a three phase circuit and validate the result manually.
9. Determine error in single phase energy meter by calibration.
10. Determine physical parameters using different type of transducers and validate the result manually

Text Books	
1	C. K. Alexandar and M.O. Sadiku, "*Fundamentals of Electric Circuits*", McGraw Hill Education, 6th Edition,2018, ISBN: 9780078028229
2	H. S. Kalsi "*Electronic Instrumentation*", McGraw Hill Education, Third edition, 2010, ISBN: 9780070702066

References	
1	James W. Nilsson and Susan A. Riedel "*Electric Circuits*" Prentice Hall, 10th Edition, 2015, ISBN: 0131989251
2	A. K. Sawhney, "*A Course in Electrical and Electronics Measurement and Instrumentation*", Dhanapat Rai& Company, New Delhi, reprint, 19th Edition, 2010, ISBN: 9788177001006

Useful Links	
1	https://nptel.ac.in/courses/108/105/108105153/
2	https://nptel.ac.in/courses/108/105/108105064/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1					3										
CO2					3										
CO3					2										

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15	10	10	**35**
Apply	15	20	30	**65**
Analyze				
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Analog and Digital Circuits Lab
Desired Requisites:	Basic Electronics Lab

Teaching Scheme (Hrs)		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2				
Interaction	-	**Credits: 1**			

Course Objectives

1	This lab course intends to provide basic practical knowledge of various ICs for developing linear integrated circuits.
2	It intends to impart skills to implement different electronic circuits using operational amplifier.
3	It aims to develop an ability to simulate and implement combinational and sequential circuits.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Distinguish** various analog and digital circuits.	Understanding
CO2	**Illustrate** linear integrated circuits using electronic components like Op-amps, transistors, etc.	Applying
CO3	**Implement** applications of various analog and digital circuits.	Applying

List of Experiments / Lab Activities

List of Experiments:

1. Demonstration of the performance of opamp in inverting, non-inverting and buffer configuration
2. Implementation of a difference amplifier using operational amplifier
3. Design of Summing, Averaging and Scaling Amplifier using opamp
4. Implementation of Instrumentation Amplifier using opamp
5. Construction of Schmitt Trigger using opamp
6. Demonstration of the performance of half and full wave rectifier.
7. Design of a first order Active Low Pass filter using opamp
8. Design of a first order Active High Pass filter using opamp
9. Development of various types of clippers and clampers.
10. Use of op-amp as differentiator & integrator.
11. Illustration of op-amp as zero crossing detector & peak detector.
12. Development of phase shifter circuit using op-amp.
13. Design of the astable and mono stable multi vibrators using IC 555
14. Demonstration of the D and JK flip flop
15. Implementation of the circuits of decoders and multiplexers.
16. Experimentation of decade counters.
17. Implementation of Half and Full Adder circuits

Text Books	
1	Sergio Franco, "*Design with Op-Amps and analog Integrated Circuits*", Tata McGraw-Hill Publication, Third Edition, 2001
2	Allen Mottershead, "*Electronic Devices &Circuits: An Introduction*", Prentice Hall India, 2010
3	A. Anand Kumar, "*Fundamentals of Digital Circuits*", Prentice Hall India, Fourth Edition, 2014

References	
1	R.A. Gayakwad, "*Op-Amps & Linear Integrated Circuits*", Prentice Hall India, Fourth Edition, 2012.
2	R. L. Boylestad and Louis Nashelsky, "*Electronic Devices & Circuit Theory*", Pearson Publications, Tenth Edition, 2009.
3	M. Moris Mano and Michael Ciletti, "*Digital Design*", Pearson Publications, Fifth Edition, 2013

Useful Links	
1	https://nptel.ac.in/courses/108/102/108102112/
2	https://nptel.ac.in/courses/108/102/108102095/
3	https://nptel.ac.in/courses/108/105/108105132/

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				3											
CO2				3											
CO3					3										

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15	5	15	**35**
Apply	15	25	25	**65**
Analyze				
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Mandatory Life Skill Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Environmental Science
Desired Requisites:	NIL

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 0**			

Course Objectives	
1	Infuse an understanding of the various environmental concepts on scientific basis in the functional area of Engineering and technology
2	Provide a foundation to critically assess the approaches to pollution control, environmental and resource management, sustainable development, cleaner technologies, Environmental Legislation based on an understanding of the fundamental, environmental dimensions
3	Inculcate the modern concept of green industry and the impact of excess human population, globalization, and climate change on the environment.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Describe** key concepts of Environmental science and their relationship to engineering.	Understanding
CO2	**Explain** ethical and legal responsibility of an engineer and his role in effective implementation of sustainable activities through EIA and EMS in the corporate sector	Understanding
CO3	**Predict** impact of contemporary issues (Population Explosion, Climate change, Environmental pollution) on the environment	Understanding

Module	**Module Contents**	**Hours**
I	**Environment, Ecology and Biodiversity** Introduction: Natural and Built Environment, Environmental education: definition, scope, objectives and importance, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere. Ecology : Introduction, Types (terrestrial and aquatic ecosystems) , Structure and function, Trophic levels, Food chains, food webs, Ecological pyramids, Ecological succession, Biogeochemical cycles. Biological Diversity: Introduction, Value of biodiversity: consumptive use, Threats to biodiversity, Conservation of biodiversity.	7

II	**Human Population, Energy and Natural Resources** Human Population Growth and Environment: Population Dynamics, Age structures, Energy Scenario: Future projections of Energy Demand, Utilization of various Energy Sources, Conventional Energy Sources and Non-Conventional Energy Sources, Urban problems related to energy. Natural Resources: Food, Water, Forest, Geological, Equitable Use of Resources for Sustainable life style. Case studies	5
III	**Climate Change, Environmental Quality and Pollution Control** Climate change: Global warming, Ozone depletion, Acid Rain. Environmental Impact: Impact of Modern agriculture on the Environment, Impact of Mining on the Environment, Impact of Large dams on the Environment, Environmental pollution: Air, Water, Soil, Noise, Marine, classification of pollutants, their causes, effects and control measures. Case studies.	5
IV	**Solid, Hazardous Waste and Disaster Management** Solid and Hazardous waste management: Introduction, categories, causes, effects and management of municipal solid waste, Hazardous waste Disaster Management: Introduction, types of disasters, Disaster mitigation. Case studies	4
V	**Social Issues, Environmental Management and Legislation** Environmental ethics: Introduction, Ethical responsibility, issues and possible solutions. Environmental Management: Introduction to Environmental Impact Assessment, Environmental Management System: ISO 14001Standard, Environmental Auditing, National and International Environmental protection Agencies pertaining to Environmental Protection. Environmental Legislation: Environmental protection act 1986, Water (prevention and control of pollution) Act 1974, Air (prevention and control of pollution) Act 1981, Wild life Protection Act 1972, and Forest Conservation Act 1980.Municipal Solid Wastes (Management and Handling) Rules, 2000	4
VI	**Cleaner technology** Restoration Ecology, Role of Information Technology in Environment science, Green buildings, Green products, Consumerism and Waste Products, Minimization of Hazardous Products, Reuse of Waste, By-products, Rainwater Harvesting, Translocation of trees. Some Success Stories. Case studies	3
Text Books		
1	Mrinalini Pande, "*Disaster Management*", Wiley Publications New Delhi, First edition, 2014	
2	N.K Uberoi, "*Environmental Studies*", Excel Books Publications New Delhi, first edition, 2005.	
References		
1	William. Cunningham and Barbara Woodworth Saigo, "*Environmental Science: A Global Concern*", WCB/McGraw Hill publication, 5th Edition, 1999.	
Useful Links		
1	NIL	

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2	2							2	
CO2							3	2							
CO3							2								
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	20	20	60	100
3	Apply				
4	Analyze				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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Course Content of

S.Y. B. Tech. (Electrical Engineering) Sem- IV (EVEN)

2021-22

Professional Core (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Applied Mathematics for Electrical Engineers
Desired Requisites:	Engineering Mathematics I and Engineering Mathematics II

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To develop Mathematical skills and enhance thinking power of students.
2	To introduce fundamental concepts of mathematics and their applications in engineering fields

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Explain** Mathematical concepts in Engineering field.	Understanding
CO2	**Use** Mathematical and Computational Methods to solve the problems in science and Engineering field.	Applying

Module	**Module Contents**	**Hours**
I	**Linear differential equations with constant coefficients** Definition, Complete solution , The operator D ,Auxiliary equation, Rules for finding the complementary function, Inverse Operator, Rules for finding the particular Integrals, Homogeneous linear differential equations.	6
II	**Laplace Transform and Its Applications** Definition, Transform of Standard functions, Properties, Transform of derivative and Integral, Inverse Laplace Transform, Convolution Theorem, Applications to solve linear differential equations, Laplace transform of periodic functions.	8
III	**Fourier Series** Periodic functions ,Dirichlet's conditions, Definition , Determination of Fourier coefficients (Euler's formulae), Expansion of functions, Even and odd functions, Change of Interval and functions having arbitrary period, Half range Fourier sine and cosine series.	6
IV	**Fourier Transform** Definition, Fourier Sine and Cosine Integral, Fourier sine and Cosine transform Inverse Fourier sine and Cosine transform, Properties, Parseval's Identity.	5
V	**Partial differential equations and its Application** Partial differential equations, Four standard forms, application to one dimensional Heat equation.	6

VI	**Complex Analysis** Introduction ,Function of complex variable, limit and Continuity of a function of complex variable, Differentiability , Analytic function, Harmonic function, Complex integration, Integral theorem and formula, Zero of analytic function, Singular point, Pole, Cauchy Residue theorem.	8
Text Books		
1	Erwin Kreyszig ,*"Advanced Engineering Mathematics"*, Wiley Eastern Ltd. Publication,1st Edition,1978.	
2	P.N. and J.N. Wartikar *"A Text Book of Applied Mathematics"*, Vol I and II, Vidyarthi Griha Prakashan, Pune, 2006.	
3	B.S.Grewal *, "Higher Engineering Maths*", Khanna Publication, 39th Edition, 2005.	
References		
1	Wylie C.R. ,*"Advanced Engineering Mathematics"*, Tata McGraw Hill Publication, 8th Edition,1999.	
2	H.K. Dass, "*Advanced Engineering Mathematics*" ,S. Chand and company Ltd., 1st Edition 1988.	
Useful Links		
1	https://www.youtube.com/watch?v=lkAvgVUvYvY	
2	https://www.youtube.com/watch?v=c9NibpoQjDk	

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2														
CO2	2														
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10	10	20	40
3	Apply	10	10	40	60
4	Analyze				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	AC Machines
Desired Requisites:	DC Machines & Transformer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course intends to provide basic concepts of operation and performance of asynchronous and synchronous machines.
2	It intends to develop implicational skill to operate asynchronous and synchronous machines.
3	It intends to develop skill to determine performance asynchronous and synchronous machines.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Explain** the working principle, construction and operation of asynchronous and synchronous machines.	Understanding
CO2	**Solve** numerical on asynchronous and synchronous machines.	Applying
CO3	**Analyse** the performance of synchronous and asynchronous machines.	Analysing

Module	**Module Contents**	**Hours**
I	**Synchronous Generator** Construction, Principle of operation, EMF equation, leakage reactance, armature reaction, armature resistance and reactance, field excitation system, damper winding	5
II	**Performance of Synchronous Generator** Calculation of voltage regulation by synchronous Impedance method, zero power factor method, MMF method, experimental setup for above method, rating, efficiency and losses, method of synchronizing, synchronizing power, hunting, damping operation single and Infinite bus, power angle equation, short circuit ratio and its significance. Two Reaction Theory: Phasor diagram, slip test, power angle equation, saliency power.	6
III	**Synchronous Motor** Method of starting, phasordiagram, torque and torque angle equation, V – curves and experimental setup, hunting and damping, synchronous condenser.	5

IV	**Three Phase Induction Motor** a. Construction, Principle of operation: Phasor diagram, equivalent circuit, analysis based on approximate equivalent circuit, Torque equation, speed equation, speed torque curve, b. Slip ring Induction Motor: Effect of increase in rotor resistance, starting, speed control of motor. c. Speed control of Induction Motor: Change of supply frequency, pole changing, cascading, Injection of EMF in secondary. d. Application and Testing: Testing as per I.S.S., Industrial applications of induction motor.	8
V	**Computations and Classification of Three Phase Induction Motor:** a. **Computations:** No load test, Blocked rotor test, and circle diagram, starting and types of starter, ratio of starting torque to full load torque. b. **Double Cage Induction Motor (D.C.I.M.):** Construction, Characteristics and Equivalent circuit. c. **c) Synchronous Induction Motor:** Construction, Circle diagram, Phasor diagram.	8
VI	**Single Phase Induction Motor and, Three Phase Motor Winding** a. **Single Phase Induction Motor:** Types, Construction, Principle of operation, phasordiagram, equivalent circuit, Experimental determination of parameter, application. b. **Three Phase Motor Winding** Single layer, double layer, Integral and fractional slot winding, distribution factor, pitch factor, Elimination of harmonics voltage.	7

Text Books	
1	M. G. Say. "*Performance Design of AC Machines*", CBS Publishers, 4thEdition, 1976.
2	O. E. Taylor, "*Performance Design of AC Commutator Motors*", Wheeler Publisher, 15th Reprint.

References	
1	J. Chapman, "Electrical Machine", McGraw Hill, 5th Edition, 2009.
2	J. B. Gupta, "*Electrical Machines*", SK Kataria and Sons, 3rd edition, 2011.
3	Fitzerald and Kingsley,"*Electric Machine*", Tata McGraw Hill, 2nd Edition, 2000.

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		3												3	
CO3				2										3	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		20	30
3	Apply	10	10	20	40
4	Analyze		10	20	30
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Electrical Transmission and Distribution
Desired Requisites:	Electrical Circuits, DC Machines and Transformers

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	Power system forms a major part of electrical systems. This course will appraise the students about the structure and performance analysis of power systems.
2	This course will develop analytical skills in the students for investigating issues related to power systems.
3	This course will help students in preparing for competitive examinations.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Summarize** structure and performance parameters of power system	Understanding
CO2	**Interpret** the performance of generation, transmission and distribution system.	Applying
CO3	**Scrutinize** voltage and power factor control methods for improving performance of transmission and distribution systems	Analyzing

Module	**Module Contents**	**Hours**
I	**Structure of Power Systems and parameters of transmission lines** Generation, transmission, distribution and utilization of electrical power, types of lines, types of conductors, voltage levels, R, L, C parameters.	6
II	**Mechanical aspects of transmission lines** Electrical clearances, safety norms, Sag calculations, effect of wind and ice covering of sag, types of insulators, support structures, corona.	7
III	**Transmission line representation and performance calculation** Single Line Diagram (SLD), String Efficiency of insulators, PU quantities, short, medium and long line models, performance calculations, ABCD constants, Power Circle Diagram.	7
IV	**Distribution Systems and Underground Cables** Types of feeders, distributors, AC and DC distribution systems, sub-stations, UG cables for LT and HT systems.	6
V	**Voltage control and Power factor improvement** Methods of voltage control, AVRs, tap changing transformers, causes of low p.f., effects of low p.f., Shunt capacitors, calculation of reactive power injection and p.f. correction.	6

VI	**Economic operation of power systems** Basics of Economic load sharing, Incremental fuel cost, Economic dispatch neglecting transmissions losses, penalty factor, General Loss Formula, optimum load dispatch considering transmissions losses.	6

Text Books	
1	Ashfaq Husain, "*Electrical Power Systems"*, CBS, 5th Edition, 2007.
2	Glover, Sharma, Overbye, " *Power Systems Analysis and Design"*, Thompson, 5th Ed., 2012.
References	
1	Nagrath, Kothari, "*Modern Power System Analysis"*, TMH, 2nd Edition, 2015
2	HadiSaadat, "*Power System Analysis"* , TMH, 1st Edition, 2002.
3	Stevenson W.D., " *Elements of Power System Analysis"*, TMH, 4th Edition, 2014.
Useful Links	
1	https://nptel.ac.in/courses/108/105/108105104/

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1												2		
CO2		3											2		
CO3			2										2		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		20	30
3	Apply	10	10	20	40
4	Analyze		10	20	30
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Power Electronics
Desired Requisites:	Analog and Digital Circuits

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course intends to provide basic knowledge of different power electronic devices, rectifiers, converters, inverters and choppers.
2	It is aimed to impart skills of analysis for different types of converters such as rectifiers, controlled converters, inverters and choppers.
3	Make the students acquainted with design of different types of converters such as rectifiers, controlled converters, inverters, choppers and their associated control circuit.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Describe** the basics of semiconductor switches, rectifier, control converter, inverter, choppers, and cyclo-converter and matrix converter circuits.	Understand
CO2	**Calculate** the performance of semiconductor switches, rectifier, converter, inverter, choppers, and cyclo-converter and matrix converter circuits.	Apply
CO3	**Analyze** the Power Electronic Circuits such as rectifier, converter, inverter, choppers, and cyclo-converter and matrix converter circuits.	Analyze

Module	**Module Contents**	**Hours**
I	**Power Semiconductor Switches:** Characteristics of ideal switch, V-I Characteristics, Rating, protection and cooling of power semiconductor devices such as power diodes, transistor, MOSFET, IGBT and GTO, Study of the driver circuits for thyristor, GTO and IGBT, Introduction to smart power modules, Comparative study of MOSFET, thyristor, GTO, BJT and IGBT.	6
II	**Single Phase and Three Phase AC to DC rectifiers** Single phase half wave and single phase full wave diode bridge. Three phase half wave and three phase full wave diode bridge, Transformer power rating for above configurations. Source current and output voltage analysis.	6

III	**Phase Controlled AC to DC Converters** Classification of converters, Single phase half controlled and fully controlled thyristor converters, Three pulse and six pulse controlled converters, operation of converter with freewheeling diode. Effect of source inductance on the performance of the converter, overlap – angle. Performance factors for the converter such as displacement factor, distortion factor, total harmonic distortion, ripple factor and transformer utilization factor. Introduction to 12 pulse converter, single phase and three phase dual converter, firing scheme for 1 phase and three phase converter, Brief introduction to commutation methods. Introduction to PWM converters.	8
IV	**DC to DC Converters** Control of DC to DC converters, step down (buck) converter, Analysis of buck converter with RLE load, step up converter, buck – boost converter, full bridge DC to DC converter, concept of multiphase choppers, cuk converter.	6
V	**Switch Mode DC – AC Inverters** Basic concepts of switch mode inverters, types: VSI and CSI, single phase half bridge and full bridge inverter, three phase six step inverter, 120^0 mode of conduction, 180^0 mode of conduction, three phase PWM Inverter, sinusoidal PWM and selective harmonics elimination methods of PWM. Effect of blanking time on output voltage in PWM inverters, auto sequentially commutated CSI, Solar Inverters, Introduction to multilevel inverters.	7
VI	**Cycloconverters and Matrix Converter** Introduction to Single phase and three phase cycloconverters. Working and topologies of Matrix converter, control methods, performance analysis of matrix converter.	6

Text Books	
1	M.H.Rashid "*Power Electronics, Circuits, Devices and Applications*", Pearson Education Inc., 4th Edition, November 2017.
2	P. S. Bhimra, "*Power Electronics*",3rd Edition, Khanna Publishers, 2002.

References	
1	B.K. Bose, "*Modern Power Electronics and A.C. Drives*", Prentice Hall of India Pvt. Ltd. Publication, 2002.
2	Mohan, UndelandRobins, "*Power Electronics, Converter Applications and Design*", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3	G. K. Dubey and Others "*Thyristorised Power Controller*", New Edge International Publishers, 1st Edition Reprint, 2005.

Useful Links	
1	NPTEL lectures on Power Electronics

CO-PO Mapping															
	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		3													
CO3		3													
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10	10	20	**40**
3	Apply	10		20	**30**
4	Analyze		10	20	**30**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Signals and Systems
Desired Requisites:	Engineering Mathematics I, II and III

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	1	20	20	60	100
Practical	-				
Interaction	-	**Credits: 4**			

Course Objectives

1	This course intends to provide basic knowledge of theoretical structure, formal representation, computational methods, notation, and vocabulary of linear models.
2	It is aimed to impart skills to perform signal analysis with reference to spectrum analysis of deterministic signals.
3	Imparting basic knowledge of signals and systems analysis.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Describe** the mathematical principles of continuous time, discrete-time systems and applications of signal processing techniques.	Understanding
CO2	**Calculate** the response of linear systems in time domain using various tools such as convolution, Laplace transform, Z transform etc.	Applying
CO3	**Analyse** frequency domain behaviour of linear systems using Fourier transform techniques.	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction to Signals and Systems** Continuous and Discrete - Introduction, standard signals, signal representation, classification of signals, systems – representation, classification, Linear, Time invariant, causal, BIBO stable, Static, dynamic.	7
II	**Time Domain Analysis of Continuous and Discrete Time Systems** Zero state and Zero input response, Impulse response, Convolution and its properties, Convolution integral, Properties of Convolution integral, Convolution sum, Properties of Convolution sum, graphical representation of convolution.	7

III	**Fourier Domain Analysis of Continuous Time Signal** Trigonometric Fourier series, Compact Trigonometric Fourier series, Exponential form, Dirichlet Conditions, Frequency domain representation of periodic signals, Fourier Transform representation of aperiodic signals, Properties of CFT duality, time reversal, Convolution – time and frequency domain.	7
IV	**Laplace Transform Analysis of Signals and System** Definition, Properties, Solution of differential equation. Transfer function, Poles and Zeroes, System analysis using Laplace Transform.	6
V	**Fourier Domain Analysis of Discrete Time Signal** Representation of CT signals using Samples, Nyquist Sampling Theorem Discrete time Fourier Transform, Representation of aperiodic sequence, Properties of DTFT: time reversal, Linear Convolution – time and frequency domain, conjugate symmetry.	6
VI	**Z- Transform Analysis of Discrete Time Signals and Systems** Definition, Properties, Solution of difference equation. Transfer function, Poles and Zeroes, System analysis using Z-Transform, FIR, IIR systems.	6

Text Books	
1	A.V. Oppenheim, A.S. Wilsky, S.H. Nawab, "*Signals and Systems"*, 2nd Edition, Prentice Hall, 1998.
2	B. P. Lathi, "*Principles of Linear systems and signals*, 2nd Edition, Oxford University press, 2005.

References	
1	M. J. Roberts, "*Signals and systems"*, 3rd Edition, Tata McGraw Hill, 2011.
2	Simon Haykin, Barry Van Veen, "*Signals and systems"*, 2nd Edition ,Wiley Publications, 2007.

Useful Links	
1	

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		3													
CO3		3													

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		20	30
3	Apply	10	10	20	40
4	Analyze		10	20	30
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Professional Core (Lab) Courses

Walchand College of Engineering, Sangli

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Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	AC Machines Lab
Desired Requisites:	Basic Electrical Engineering, DC Machines and Transformers

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/Week				
Interaction	-	**Credits: 1**			

Course Objectives

1	This course intends to demonstrate performance operation of synchronous and asynchronous machines.
2	It intends to develop skills to analyse operation and performance of asynchronous and synchronous machines.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Demonstrate** experiment to verify electrical characteristics and performance of induction and synchronous machines.	Applying
CO2	**Analyse** performance of induction motors and synchronous machines.	Analysing
CO3	**Estimate** appropriate ratings and develop circuit connections for an experiment as a group activity.	Analysing

List of Experiments / Lab Activities

List of Experiments:

1. No load and Blocked rotor test on induction motor and performance of I.M. from circle diagram
2. Study of A.C. Machines parts.
3. Study of Induction motor starters.
4. Speed control of Induction Motor
5. Parameter calculation of single phase induction motor from No load and Blocked rotor test
6. Determination of voltage regulation of alternator using Synchronous Impedance method.
7. Determination of voltage regulation of alternator using MMF method
8. Determination of voltage regulation of alternator using Zero power factor method.
9. Synchronization of alternator with bus bar
10. Parallel operation of alternator.
11. V-Curves of Synchronous motor.
12. Study of starting method of synchronous motor.

Text Books	
1	M. G. Say. *"Performance Design of AC Machines",* CBS Publishers, 3rd Edition.
2	O. E. Taylor, "*Performance Design of AC commutator motors*", Wheeler Publisher, 15th Reprint.
References	
1	J. Chapman, "*Electrical Machine*", 3/E, S McGraw Hill.
2	J. B. Gupta, "*Electrical Machines*", SK Kataria and Sons, New Delhi.
3	Fitzerald and Kingsley, "*Electric Machine*", Tata McGraw Hill.

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		3													
CO3															1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	5	15	**35**
Analyze	15	25	25	**65**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Electrical Transmission and Distribution Lab
Desired Requisites:	Electrical Circuits, DC Machines and Transformers

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	**2 Hrs**				
Interaction	-	**Credits: 1**			

Course Objectives

1	This laboratory course covers basic study of various components/parts of power system, used in practice
2	It provides hands on skill to conduct simulation studies and analyze the performance of transmission and distribution systems
3	It lays the foundation for conducting higher level study in power systems

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Identify** various components of power system and their use	Analyze
CO2	**Estimate** the performance of transmission and distribution systems using simulations	Evaluate
CO3	**Verify** the voltage control and power factor improvement by performing case studies	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1. Distinguish various symbols used in representation of electrical power system and draw various symbols.
2. Visit to local substation (33KV) for study of various components used in transmission and distribution.
3. Visit to pole mounted substation and study Single Line Diagram of WCE for study of HT and LT distribution system.
4. Development of the MATLAB program for per unit representation of power system quantities.
5. Modelling of transmission line and performance evaluation using MATLAB/MiPower software3
6. Fabrication of scaled model of insulator string and determination of string efficiency and design calculation of transmission towers.
7. Determination of transmission line performance using Transmission Line Simulator (TLS).
8. Calculation of size and rating of capacitor bank for Power Factor Improvement-Case Study.
9. Verification of voltage control by off load transformer tap changing.
10. Examination of economic dispatch using power world/MiPower/MATLAB simulation

Text Books

1	*"Power System Analysis"*: by Hadi Saadat, McGraw-Hill, International edition, 1999.
2	Glover, Sharma, Overbye, "*Power Systems Analysis and Design"*, Thompson, 5th Ed., 2012

3	Ashfaq Husain, " *Electrical Power Systems",* CBS, 5th Edition, 2007
References	
1	Nagrath, Kothari, " *Modern Power System Analysis" ,* TMH, 2nd Edition, 2015
Useful Links	
1	Computer Usage / Lab Tool: MATLAB/TLS/Power world/MiPower Simulator

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1				3											
CO2					3										
CO3				2											
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply				
Analyze	15	5	15	**35**
Evaluate	15	25	25	**65**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Power Electronics Lab
Desired Requisites:	Analog and Digital Circuits

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./Week				
Interaction	-	**Credits: 1**			

Course Objectives

1	This course intends to provide the practical knowledge of different power electronics devices.
2	It is aimed to impart skills of working of different power electronic converter through simulation and experimentation.
3	Make the students acquainted with simulation, analysis and design of power electronic converters.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Demonstrate** experiments on basics of converters such as rectifier, inverter, and Chopper etc.	Apply
CO2	**Construct** different types of converters such as rectifier, inverter and Chopper with their control techniques using simulation.	Analyze
CO3	**Measure** the performance of converters such as rectifier, inverter, and Chopper.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1. Verify the Voltage and current relationship in 3 phase full wave diode bridge rectifier and evaluate the input current harmonic spectrum.
2. Evaluate the load side performance of single phase full wave half control converter.
3. Evaluate the load side performance of single phase full wave full control converter.
4. Evaluate the load side performance of three phase full wave half controlled converter.
5. Evaluate the load side performance of three phase full wave full controlled converter.
6. Develop the firing angle control scheme for single phase full wave, half controlled and full controlled converters.
7. Develop the firing angle control scheme for three phase full wave half controlled converter.
8. Develop the firing angle control scheme for three phase full wave full controlled converter.
9. Evaluate the performance of MOSFET based buck converter.
10. Evaluate the performance of MOSFET based boost converter.
11. Develop the control circuit for single phase PWM Inverter.
12. Develop the control circuit for three phase square wave Inverter.

Text Books	
1	M.H.Rashid "*Power Electronics, Circuits, Devices and Applications*", Pearson Education Inc., 4th Edition, November 2017.
2	P. S. Bhimra, "*Power Electronics*",3rd Edition, Khanna Publishers, 2002.

References	
1	B.K. Bose, "*Modern Power Electronics and A.C. Drives*", Prentice Hall of India Pvt. Ltd. Publication, 2002.
2	Mohan, Undeland and Robins, "*Power Electronics, Converter Applications and Design*", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3	G. K. Dubey and Others "*Thyristorised Power Controller*", New Edge International Publishers, 1st Edition Reprint, 2005.

Useful Links	
1.	NIL

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				3					2						
CO2					3										
CO3				3					2						

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	10	10	**35**
Analyze	15	10	20	**45**
Evaluate		10	10	**20**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Presentation and Report Writing
Desired Requisites:	MS-Office

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical					
Interaction	1 Hrs/Week	**Credits: 1**			

Course Objectives

1	To convey ethical guidelines during technical content preparation and showcasing
2	To make aware of soft tools for information handling
3	To provide various relevant benchmark case studies
4	To share rubric assessing reading, writing and presentation skills

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Follow** ethical guidelines during technical writing and presentations	Understanding
CO2	**Choose** and practice tools for sharing and linking the information	Applying
CO3	**Compare and identify** suitable platforms towards practicing write-up and demonstrations	Analysing
CO4	**Discuss** within groups to assess his/her own improvement in overall technical expressions	Evaluating
CO5	**Create** contented reports and meaningful presentations authoring the work	Creating

List of Experiments / Lab Activities

List of Sessions:

PART – A Technical Report Writing

1. **Session 1**: Writing technical reports using proper Tense and grammar.
2. **Session 2:** Study of various types of technical Reports
    a. Project report
    b. Conference paper
    c. Journal Paper
    d. Intellectual Property Rights (IPR)
    e. Selection of paper type for possible publication.
3. **Session 3**: Study of technical report Structure - I
    a. Preamble
    b. Abstract
    c. Literature review/survey
    d. Problem statement
    e. Objectives
4. **Session 4**: Study of technical report Structure – II
    a. Methodologies
    b. Results
    c. Discussions
    d. Conclusion
    e. Acknowledgements
5. **Session 5**: Use of Bibliographies/references and proper citations in reports.
6. **Session 6**: Use of Citations, referring style and method of using citations.
7. **Session 7**: Study of Plagiarism
    a. Checking plagiarism
    b. Minimizing plagiarism

PART – B Presentation

8. PPT's and Animations
9. Presentation structure, Number of slides and Time management
10. Presentation styles
11. Figures and Tables for data representations

Part –C Tools and Practices

12. MS Office, Open Office, Latex, Beamer, Flash, GNU Plot etc.
13. End Note; Mendeley, Grammarly, Ginger, 1 Checker, Turnitin etc.

Text Books	
1	Kothari C. R, *"Research Methodology*", 2nd Edition, New Age International, 1990
2	Chopra Deepak and Sondhi Neena, *"Research Methodology : Concepts and cases",*2nd Edition,Vikas Publishing House, New Delhi,2015
3	
4	
References	
1	Melville Stuart and Goddard Wayne, *"Research Methodology: An Introduction For Science & Engineering Students",* 1st Edition,Kenwyn Juta & Co. Ltd.,1996
2	G. Ramamurthy, *"Research Methodology"*,2nd Edition, Dream Tech Press, New Delhi, 2015
3	
Useful Links	

1	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview **Academic Research & Report Writing**
2	https://onlinecourses.swayam2.ac.in/cec21_ge18/preview **Academic Writing**
3	https://onlinecourses.nptel.ac.in/noc21_ge12/preview **Qualitative Research Methods And Research Writing**
4	https://onlinecourses.nptel.ac.in/noc21_hs44/preview **Effective Writing**

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1						1		3							
CO2					2								1		
CO3					1					3					
CO4									3	2					
CO5										3		1			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10			**10**
Apply	10	10	10	**30**
Analyze	10	10	10	**30**
Evaluate		10	10	**20**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**